A Preliminary Note on a New Bacterial Disease of Pisum sativum.

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Investigations have been carried out this year at the John Innes Horticultural Institution to elucidate the nature of a disease which affects culinary peas (*Pisum sativum*).

The disease, in this district at all events, is a serious one, killing a large proportion of the crop, but I have no information as to its prevalence in other parts of the country. I have succeeded in proving that the disease in culinary peas is caused by a large bacillus which exhibits a peculiar feature, inasmuch as it is transmitted in the interior of the seeds of the plant. As far as I am aware no analogous instances are known. Owing to the work of Chamberland (1879), Lehmann (1889), Laurent (1891), and others, it has been definitely proved that not only is the interior of a normal seed sterile, but also beans and peas taken under sterile conditions from healthy pods are free from bacteria.

A very large rod-shaped bacillus has been isolated from the stem of the living pea plant and from the centre of the cotyledons of the pea. The life history of the organism is complicated by involution-forms and a zoogloeal stage. In the rod stage the bacillus is Gram-positive, non-acid-fast, very motile when young but enveloped in a capsule when at rest. It varies considerably in size according to the amount of water, food material, and other conditions. It grows well on acid (1 per cent. normal HCl), alkaline (1 per cent. normal NaOH), and neutral pea agar agar, forming small circular, pale buff, translucent, watery colonies on the surface of the medium, and when submerged the colonies are deeper in colour, opaque and lens-shaped. The colour of the colonies varies according to the medium used. Under certain conditions the colonies may have a decided orange tint. This was especially noticeable in an impure culture into which a spore of Penicillium had been introduced. The bacterial colonies immediately round the Penicillium were both larger and of a deeper tint than in other parts of the Petri dish where no fungoid growth occurred.

This orange tint has also been observed in badly diseased cotyledons after

germination, but does not necessarily occur in all cases. Further elucidation of this point is necessary.

No growth has so far been observed on lactose pea agar agar.

In liquid peptone beef broth the rods grow to a great length and are strung together in chains.

The organism occurs in the phloem, cambium, medullary rays, and occasionally in the pith of the stem, also in the parenchyma of the vascular bundles which run along the mid-rib of the pod, in the tissue of the funicle and cotyledons.

In the very young plant grown in sterile sand the bacillus has been found in the primary ground-tissue of the radicle inside the pericycle, and in the young phloem and cortical tissues of the shoot.

The general symptoms are as follows:—In mild cases after germination the shoot can develop normally, but in bad cases it is frequently abortive, brown and dead at the tip, and laterals grow out prematurely to take the place of the main shoot. Quite early in the development of the plant, when the plumule is from half an inch and upwards in length, light brown longitudinal streaks can be seen on the stem and root, and the first leaves are often brown at the tip. These streaks develop later into slits. In very bad cases little or no germination takes place. After this stage no further definite signs are noticeable till about the flowering period. Then the development of the disease depends a good deal on external conditions. If the weather is warm and dry, and the plants are growing vigorously, the disease develops rapidly, and in a few days the plants become unhealthy and change colour. The stem turns slightly brown, and looks somewhat water-soaked. Brown longitudinal streaks appear at the base of the petioles on either side of the rib of the stem, which is continuous with the mid-rib of the leaf. The streaks split open and dry out. The collar may be badly disorganised. The leaves become spotted, streaked and yellowish in colour, and if the disease is progressing rapidly the younger portions of the plant show discoloration, and fail to develop properly.

Except in bad cases the plants grow to full height, and can flower and set a certain amount of seed, but on examination the cotyledons of the seeds of a diseased plant show brown discoloration, which may be limited to a mere spot in the centre of each cotyledon, or, on the other hand, nearly the whole of the cotyledon may be involved. In the latter case there is often a cavity in the centre of the cotyledon.

Sections of the diseased cotyledon show large numbers of bacilli in various stages of development in the cells and intercellular spaces.

The bacillus works its way into the intercellular spaces and then breaks

into the cells. There the nucleus is often attacked, the cytoplasm destroyed, and the cells collapse, thus forming rents in the tissues.

There is considerable evidence to show that the bacillus passes up the plant through the tissues above mentioned, through the funicle, and probably the micropyle into the young developing seed. If one pea is diseased all the other peas in the same pod are diseased to an equal extent. The disease is chiefly spread by the seed, but fresh infection may take place through the soil.

Inoculation experiments were carried out in the open, but little stress can be laid on the results, as the disease was so prevalent throughout the experimental plot. Pea plants grown in heated soil in boxes, and inoculated just above the ground, when the plants were about 1 foot in height, showed no disease, whereas, in the open, seven out of ten inoculations on the stem just below the youngest unfolding leaf were successful.

Further inoculation experiments are necessary, but the above results tend to show that the bacillus can only penetrate very young tissue. This is supported by the fact that large numbers of the bacilli have been found in the inner tissues of the radicle when only about half an inch long.

Further investigations are in progress.

In many respects the symptoms resemble those of the formidable disease of sweet pea (*Lathyrus odoratus*) known as "streak." This disease has been held to be due to *Thielavia basicola*, but, in view of these observations, that conclusion seems very doubtful, and I may add that, in the stem of diseased sweet peas, I have already found bacteria like those here described.